



SEMINAR PENELITIAN

Sistem Alat Bantu Diagnosa Penyakit Paru Berdasarkan Citra X-RAY Thorax Berbantukan Deep Learning

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Pembimbing:

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Outline

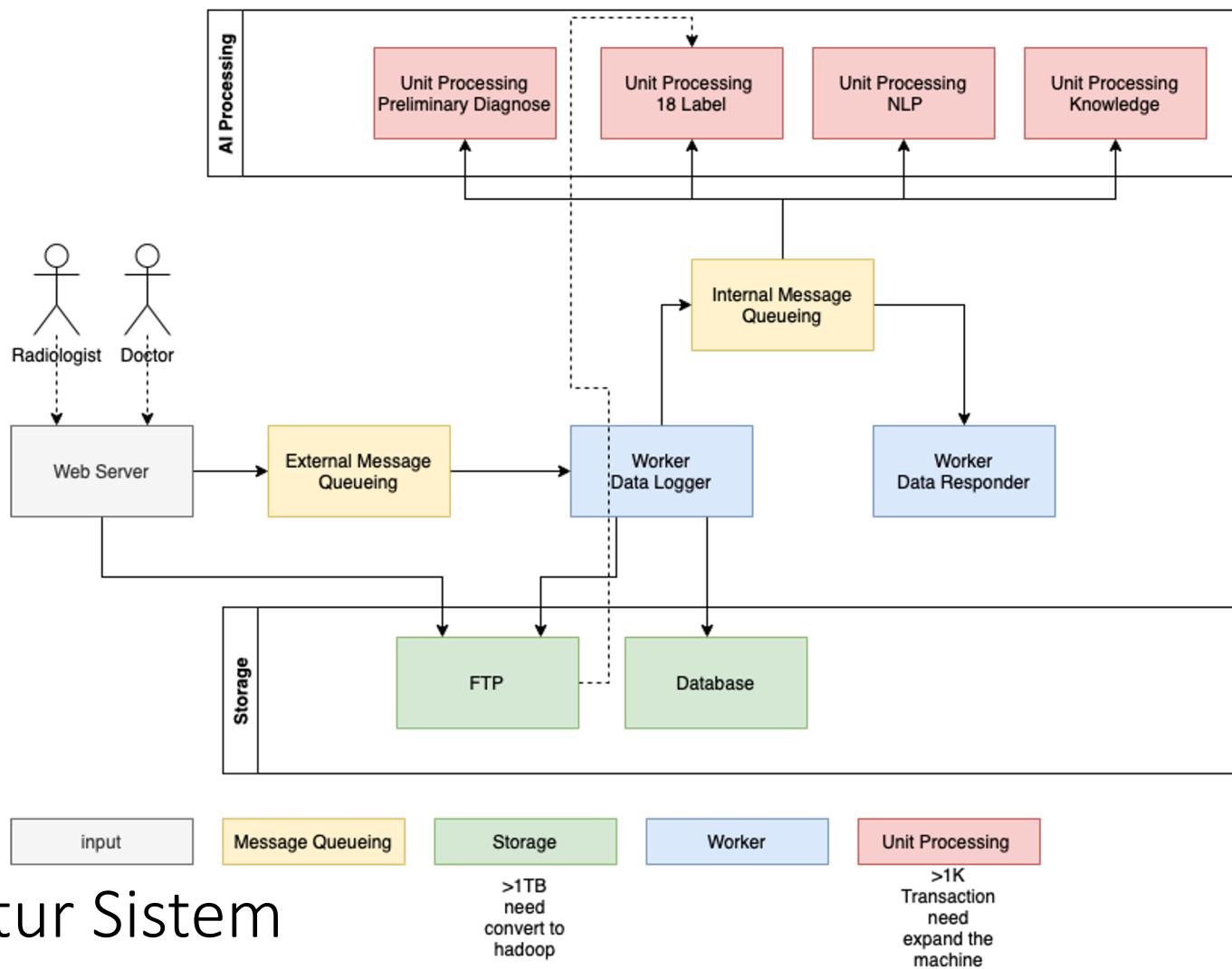
1. Pendahuluan
2. Gambaran Umum Sistem
3. Arsitektur Sistem
4. Data tersedia dan Data yang digunakan
5. Skenario Aplikasi
6. User Interface

Pendahuluan

- Rasio dokter paru per-penduduk Indonesia sebesar 1:100.000
- Rasio dokter spesialis radiologi per-penduduk Indonesia sebesar 1:164.000
- Prevalensi beberapa penyakit paru di Indonesia yang cukup tinggi
- Diagnosis sebagai prosedur kunci bagi pasien untuk memperoleh penanganan yang tepat
- Peluang sebuah sistem alat bantu diagnose penyakit paru berbantuan AI untuk membantu tenaga medis memberikan layanan kesehatan yang diperlukan

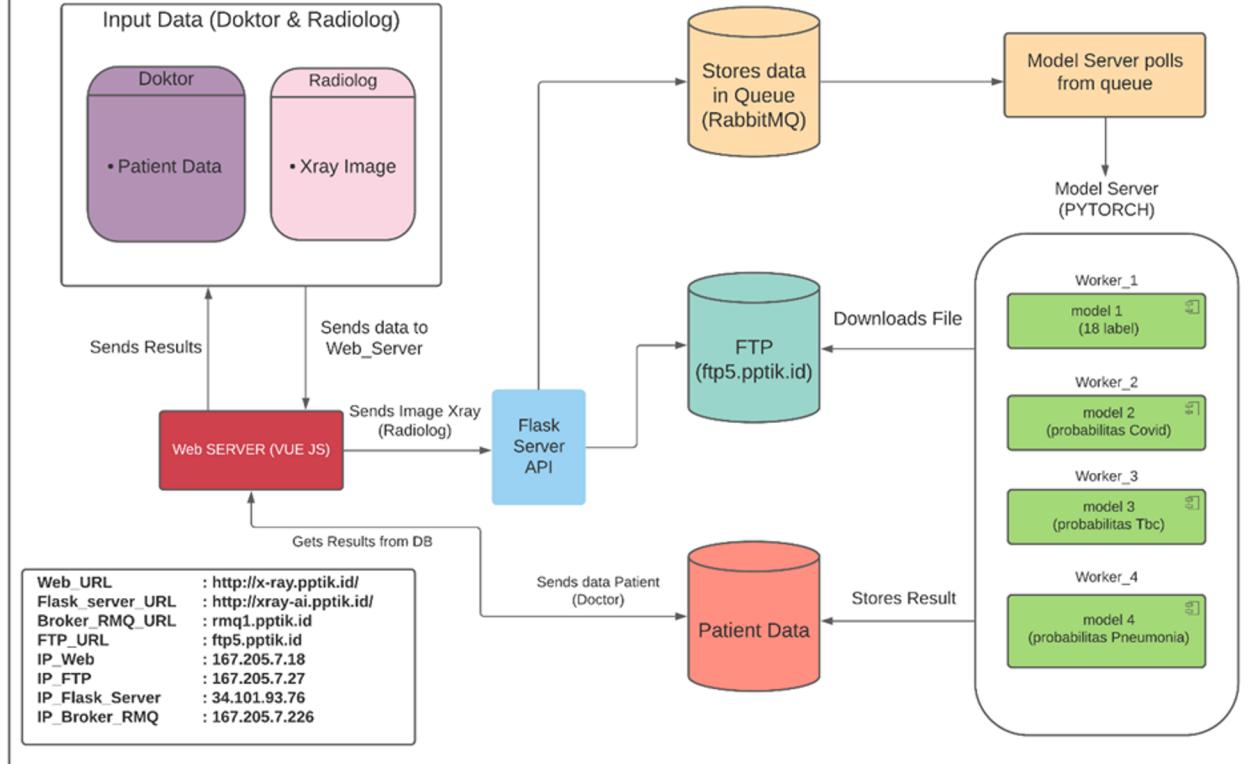
Skenario Aplikasi

1. Dokter wawancara pasien
2. Dokter input symptom
3. Radiologist melakukan scan X-ray dan upload file serta analisis X-ray
4. Mesin menjalankan proses
5. Dokter menerima hasil diagnosa mesin (preliminary diagnose)
6. Dokter melakukan analisis
7. Dokter menulis input hasil analisis
8. Dokter melakukan judgment pada pasien



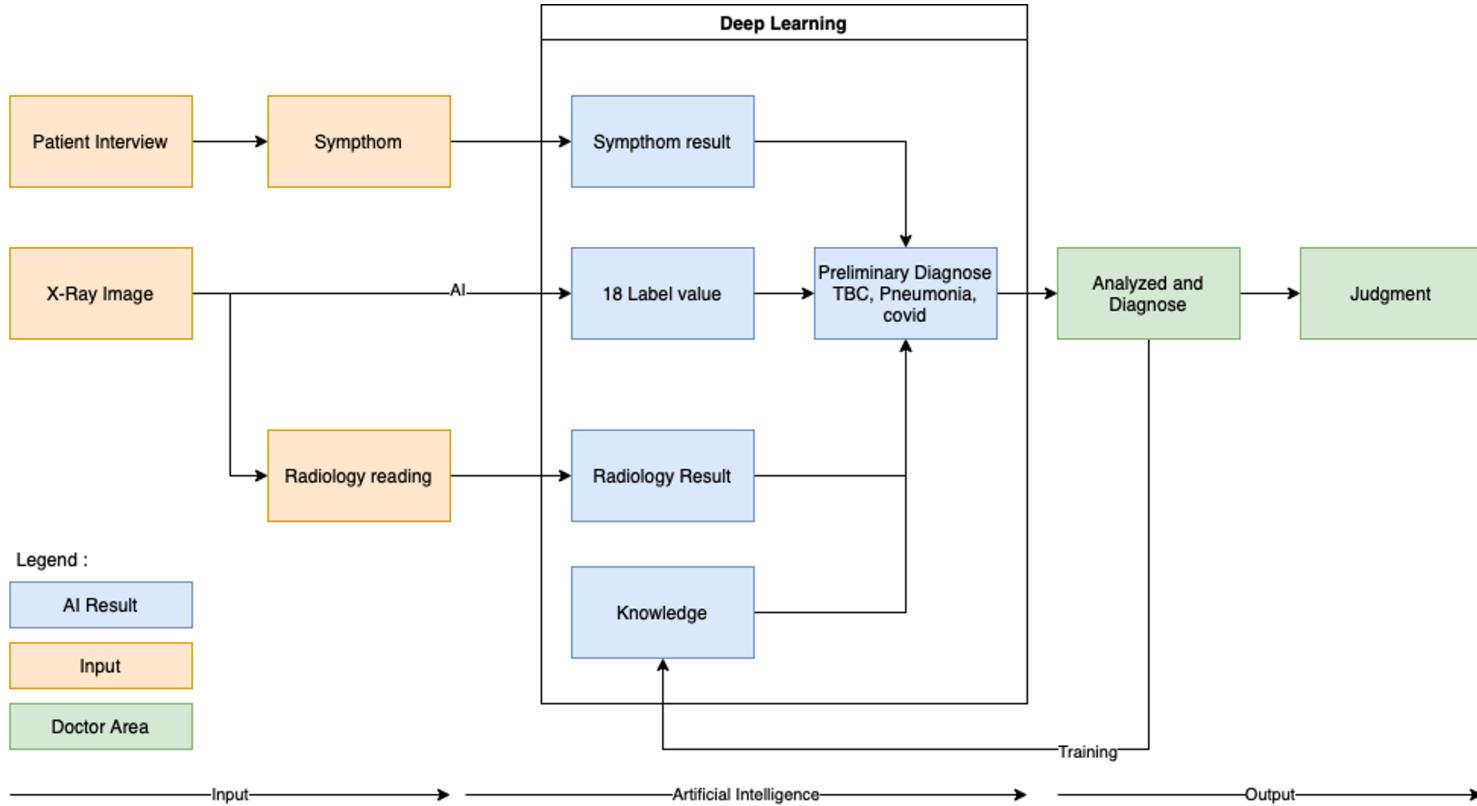
Arsitektur Sistem

Web Application Architecture



Data Flow

Spesifikasi

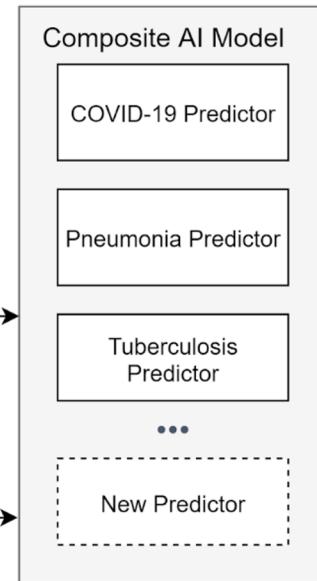
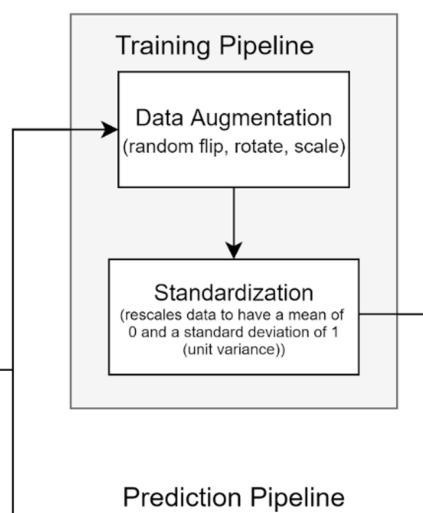


Model AI Deteksi Penyakit Paru-Paru

Chest X-ray (PA or AP view)



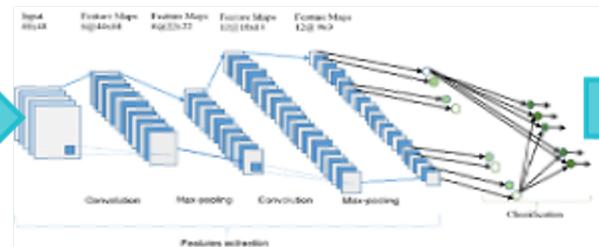
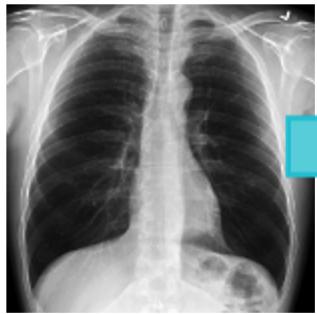
input formatting
(downscale, gray)



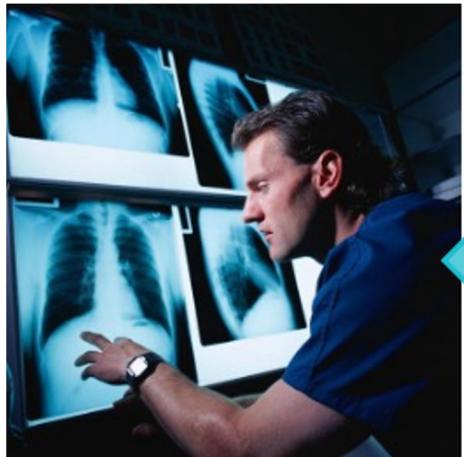
Prediction Result

```
{  
    "/local/chest-xray-pathologies/sample/covid1.png": {  
        "Pneumonia": 0.45424073934555054,  
        "COVID-19": 0.6140166521072388,  
        "Tuberculosis": 0.13159990310668945  
    }  
}
```

Gambaran Umum Sistem



```
{"Atelectasis": (0.53555715, 0.0),  
 'Consolidation': (0.5541505, 1.0),  
 'Infiltration': (0.585423, 1.0),  
 'Pneumothorax': (0.5188316, 0.0),  
 'Edema': (0.15621176, 0.0),  
 'Emphysema': (0.5120224, 0.0),  
 'Fibrosis': (0.5215088, 0.0),  
 'Effusion': (0.535236, 1.0),  
 'Pneumonia': (0.5335671, 0.0),  
 'Pleural_Thickening': (0.5501406, 0.0),  
 'Cardiomegaly': (0.20463675, 0.0),  
 'Nodule': (0.54912215, 0.0),  
 'Mass': (0.76183146, 0.0),  
 'Hernia': (0.14389276, 0.0),  
 'Lung_Lesion': (0.07749171, nan),  
 'Fracture': (0.45177916, nan),  
 'Lung_Opacity': (0.7261822, nan),  
 'Enlarged_Cardiomediastinum': (0.5274636, nan)}
```



The screenshot shows a user interface for a medical diagnostic application. At the top, there is a navigation bar with links for 'Search Dashboard', 'YOU ARE HERE > Apps > Diagnostic > Patient > ID'. Below this is a large image of a chest X-ray. To the right of the image is a table titled 'Hasil Proses' (Process Results) containing patient information and upload details. Further down is a section titled 'Analisis Gejala Klinis' (Clinical Symptom Analysis) with a table showing symptoms and their associated probabilities. A large blue arrow points from the doctor image towards this diagnostic interface.

Patient ID	Waktu Unggah	Upload ID	Status Cita
11	2020-10-27T16:54:07Z	00000000-0000-0000-0000-000000000000	Success

Analisis Gejala Klinis	Probabilitas (%)
Atelectasis	0.479903
Consolidation	0.5102919
Edema	0.02894006
Effusion	0.027015
Enlarged Cardiomediastinum	0.077008
Fibrosis	0.077008
Fracture	0.079029



Data tersedia dan Data yang digunakan

Data Set	Jumlah Data (xray)
RSNA Pneumonia Challenge	29.684
CheXpert	223.649
NIH	112.120
PadChest	160.861
Open-I	7.470
NLMTB	1.087
VinBigData	18.000
Covid Chestxray	910
Khulna	4.575
StonyBrook	2.373
Total	560.729

Sebaran Data Pembuatan Model

Pelatihan

Penyakit	NIH	RSNA	Covid Chestxray	PadChest	CheXPert	Open-I	Khulna	StonyBrook	NLMTB	TOTAL
COVID-19			381				1220	1898		3499
Pneumonia	1145	4810	534	4066	3746	62	527			14890
Tuberculosis			9	619		2			315	945

Testing

Penyakit	NIH	RSNA	Covid Chestxray	PadChest	CheXPert	Open-I	Khulna	StonyBrook	NLMTB	TOTAL
COVID-19			96				305	475		876
Pneumonia	286	1202	133	1017	936	16	132			3722
Tuberculosis			2	155					79	236

User Interface 1

The screenshot shows the X-RAY app's dashboard for a doctor named DR RAMDANI. The top navigation bar includes 'X-RAY', a menu icon, 'DR RAMDANI', and a user icon. Below the header, the text 'YOU ARE HERE > App > Dashboard' is displayed. The main section is titled 'Dashboard Doctor' and contains a table titled 'Result Patient'. The table has columns for TANGGAL, WAKTU, PATIENT ID, NAMA DOKTOR, JENIS KELAMIN, RUMAH SAKIT, STATUS RADIOGRAFI, KONFIRMASI DOKTER, and REPORT LINK. There are seven rows of data, each representing a patient record with a 'report' link.

TANGGAL	WAKTU	PATIENT ID	NAMA DOKTOR	JENIS KELAMIN	RUMAH SAKIT	STATUS RADIOGRAFI	KONFIRMASI DOKTER	REPORT LINK
2021-12-14	15:04:09	TS0-290-32T-213	DR RAMDANI	male	RS Mitra Kasih	Telah Di Finalisasi	Sudah	report
2021-12-14	15:10:19	TD-221-23	DR RAMDANI	male	RS Mitra Kasih	Menunggu Radiologi	Belum	report
2021-12-14	15:15:34	12r34	RAMDANI SUETARDI	male	Boromeus	Telah Di Finalisasi	Belum	report
2021-12-14	15:27:06	SD-2D-35	DR RAMDANI	male	RS Mitra Kasih	Menunggu Radiologi	Belum	report
2021-12-14	15:44:55	TS-231-13	DR RAMDANI	male	RS Mitra Kasih	Menunggu Radiologi	Belum	report
2021-12-14	15:52:51	23-31	DR RAMDANI	male	RS Mitra Kasih	Menunggu Radiologi	Belum	report
2021-12-14	16:03:37	IP-23	DR RAMDANI	male	RS Mitra Kasih	Menunggu Radiologi	Belum	report

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User Interface 2

The screenshot shows a medical application interface with the following sections:

- Data Umum Pasien**:
 - Fields: Nama Rumah Sakit Pasien, ID Pasien, Usia Pasien, Jenis Kelamin (radio buttons for Pria and Wanita). A note below states: "Mohon pilih salah satu jenis kelamin".
- Data Gejala Klinis**:
 - List of symptoms: 1. Suhu tubuh? ex 36.5 (Menggunakan titik dalam celsius), 2. Demam?, 3. Batuk?, 4. Mual?, 5. Diare?, 6. Berdebar?, 7. Kelelahan?, 8. Dada sakit?
 - For each symptom, there is a row of radio buttons for responses: Ya, Tidak, Tidak Tahu.

Top navigation bar: X-RAY, YOU ARE HERE > Doctor > Upload, DR RAMDANI, and a user icon.

User Interface 3

X-RAY



10. Ruam kulit?

Ya Tidak Tidak Tahu

11. Sakit dada?

Ya Tidak Tidak Tahu

12. Radang Mata?

Ya Tidak Tidak Tahu

13. Sakit perut?

Ya Tidak Tidak Tahu

14. Nafas pendek?

Ya Tidak Tidak Tahu

15. Sakit kepala?

Ya Tidak Tidak Tahu

16. Hidung berair?

Ya Tidak Tidak Tahu

17. Merasa muncium?

Ya Tidak Tidak Tahu

18. Gejala pernafasan?

Ya Tidak Tidak Tahu

19. Sakit tenggorokan?

Ya Tidak Tidak Tahu

20. Kehilangan suara gerak?

Ya Tidak Tidak Tahu

Patient status?

Diagnosa awal penyakit

sternoclavicular junction hypertrophy
sternotomy
abdomen
abdominal
abdominal surgery
abnormal foreign body
abscess
absence of right pulmonary artery
absorptiometry
acromioclavicular separation
acute pneumonia
adenopathy
adipose tissue

User Interface 4

The screenshot shows the X-RAY application interface. On the left is a dark sidebar with a 'X-RAY' logo and a navigation menu. The main area has a header with 'YOU ARE HERE > App > Dashboard' and a title 'Dashboard Radiologis'. Below is a table titled 'Result Patient' with columns: TANGGAL, WAKTU, PATIENT ID, DOKTER, STATUS, and UPLOAD. The table lists eight entries from December 14, 2021, at various times, with patient IDs ranging from TS0-290-32T-213 to IP-23. The 'STATUS' column contains green buttons labeled 'Telah Di Finalisasi' for the first four rows and blue buttons labeled 'Telah Diploaded' for the last four. The 'UPLOAD' column contains links labeled 'upload analysis'.

Result Patient					
TANGGAL	WAKTU	PATIENT ID	DOKTER	STATUS	UPLOAD
2021-12-14	15:04:09	TS0-290-32T-213	DR RAMDANI	Telah Di Finalisasi	upload analysis
2021-12-14	15:10:19	TD-221-23	DR RAMDANI	Telah Diploaded	upload analysis
2021-12-14	15:15:34	12r34	RAMDANI SUETARDI	Telah Di Finalisasi	upload analysis
2021-12-14	15:27:06	SD-2D-35	DR RAMDANI	Telah Diploaded	upload analysis
2021-12-14	15:44:55	TS-231-13	DR RAMDANI	Telah Diploaded	upload analysis
2021-12-14	15:52:51	23-31	DR RAMDANI	Telah Diploaded	upload analysis
2021-12-14	16:03:37	IP-23	DR RAMDANI	Telah Diploaded	upload analysis

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User Interface 5

The screenshot shows a user interface for uploading X-ray images. At the top left is a dark blue sidebar with the text "X-RAY" and a house icon. On the right side of the header are three icons: a menu (three horizontal lines), a user profile (DR DHANI RAMDANI), and a gear (settings). Below the header, the breadcrumb navigation reads "YOU ARE HERE > Radiografi > Upload > AHmki".

The main content area has a light gray background. It features a title "Data Citra" in bold black font. Below it is a form field with the placeholder "Pilih Citra" and a file input button labeled "Choose a file or drop it here...". To the right of the input button is a "Browse" link. A note below the input field says "Tekan tombol "Submit" jika sudah memilih file yang ingin di upload".

Below the note are five bullet points with asterisks:

- *) Mohon upload file citra keluaran mesin radiografi
- *) Silahkan upload file format .jpg atau .png
- *) Resolusi disarankan untuk X-Ray adalah 2400x2400
- *) Untuk X-Ray, mohon upload citra PA(Postero Anterior)

At the bottom of the form is a large blue "Submit" button.

On the far right of the page, the URL <http://x-ray.pptik.id> is displayed along with the number 16.

User Interface 6

X-RAY



DR DHANI RAMDANI



YOU ARE HERE > Radiografi > Upload > Analysis > Af2a3486 4ee8 40a1 A2d0 09796490d3b8



Hasil Proses

Patient ID	IP-23
Waktu Uggah	2021-12-14 16:03:56
Status Citra	success

Analisis Gejala Klinis

patient suhu tubuh	37
patient demam	Tidak
patient batuk	Ya
patient mual	Ya
patient diare	Tidak Tahu
patient berdebar	Ya
patient kelelahan	Tidak
patient menggigil	Ya
patient dada sakit	Ya
patient nyeri otot	Ya
patient ruam kulit	Ya
patient sakit dada	Ya
patient radang mata	Tidak Tahu
patient sakit perut	Ya
patient nafas pendek	Ya
patient sakit kepala	Ya
patient hidung berair	Ya
patient merasa mencium	Ya

<http://x-ray.pptik.id>

User Interface 7

X-RAY



Pre-Judgement Penyakit

sternotomy

abdominal surgery

gallbladder

foreign bodies

fibrotic band

Data Penyakit Hasil Analisis Citra AI

Label	Probability
Pneumonia	99.28%
COVID 19	17.48%
Tuberculosis	0.21%

Data Fitur Hasil Analisis Citra AI

Label	Probability	Check	Keterangan
Atelectasis	41.80%	<input checked="" type="checkbox"/>	Seharusnya 0.9%
Consolidation	50.30%	<input type="checkbox"/>	
Infiltration	53.63%	<input type="checkbox"/>	
Pneumothorax	49.81%	<input type="checkbox"/>	

User Interface 8

X-RAY



Label	Probability	Check	Keterangan
Atelectasis	41.80%	<input checked="" type="checkbox"/>	Seharusnya 0.9%
Consolidation	50.30%	<input type="checkbox"/>	
Infiltration	53.63%	<input type="checkbox"/>	
Pneumothorax	49.81%	<input type="checkbox"/>	
Edema	8.40%	<input type="checkbox"/>	
Emphysema	50.34%	<input type="checkbox"/>	
Fibrosis	51.18%	<input type="checkbox"/>	
Effusion	32.81%	<input type="checkbox"/>	
Pneumonia	56.07%	<input type="checkbox"/>	
Pleural Thickening	19.29%	<input type="checkbox"/>	
Cardiomegaly	41.22%	<input type="checkbox"/>	
Nodule	68.09%	<input type="checkbox"/>	
Mass	60.89%	<input type="checkbox"/>	
Hernia	1.10%	<input type="checkbox"/>	
Fracture	51.91%	<input type="checkbox"/>	
Lung Lesion	1.02%	<input type="checkbox"/>	
Lung Opacity	58.58%	<input type="checkbox"/>	
Enlarged Cardiomediastinum	36.32%	<input type="checkbox"/>	

Model Deteksi COVID-19

Disease	Arsitektur Model	Testing Score			
		Accuracy	Precision	Recall	F1 Score
COVID-19	ResNet50	87.03	85.06	89.83	87.38
	ResNet101	89.54	86.65	93.49	89.94
	VGG19	93.26	92.96	93.6	93.28
Pneumonia	ResNet50	84.91	83.89	86.43	85.14
	ResNet101	83.49	83.30	83.77	83.54
	VGG19	85.69	86.79	84.20	85.48
Tuberculosis	ResNet50	78.6	79.74	76.69	78.19
	ResNet101	81.78	85.71	76.27	80.72
	VGG19	81.99	87.56	74.58	80.55

Web Application Testing

- Test Case : Upload Citra Thorax Xray
- Pre-Requisite : Akun tervalidasi (radiolog)

Steps No	Action	Input	Expected Output	Test Result
1	Membuka url website (http://x-ray.pptik.id)	User : dr ahmad Pass: qwerty	Halaman Dashboard	Pass
2	Pilih daftar pasien dengan status "UPLOAD"	Klik tombol upload pada salah satu data pasien	Halaman Upload Cltra	Pass
3	Klik tombol browse dan pilih citra Xray yang sesuai dengan id pasien	Citra Xray	Halaman Dashboard dan Status Menunggu berubah menjadi Telah diupload	Pass
4	Cek hasil pemrosesan citra	Klik tombol upload analysis pada halaman dashboard sesuai dengan id pasien yang telah diinput data citranya	Halaman hasil	Pass

Web Application Testing

- Test Case : Upload Data Pasien
- Pre-Requisite : Akun tervalidasi (dokter)

Steps No	Action	Input	Expected Output	Test Result
1	Membuka url website (http://x-ray.pptik.id)	User : dr ramdani Pass: qwerty	Halaman Dashboard	Pass
2	klik tombol Diagnosis pada sidebar, lalu klik unggah data pasien	Membuka halaman unggah data pasien	Halaman Unggah Data Pasien	Pass
3	Memasukkan data pasien	Masukan data awal / gejala klinis pasien dan klik submit	Berhasil di unggah dan kembali ke halaman dashboard	Pass
4	Cek hasil unggah data	Klik tombol report link pada masing-masing pasien	Halaman hasil	Pass

Peluang Penelitian

- Memperbaiki model deep learning untuk pencapaian metrik unjuk kerja yang lebih baik
- Memperbaiki arsitektur sistem agar makin menyerupai tahapan diagnosis yang sesungguhnya; Diantaranya:
 - Menjadikan model deep learning hanya sebagai penghasil informasi patologis pada organ yang terdapat dalam citra radiologi
 - Melibatkan data klinis sebagai informasi input proses training
- Mengaplikasikan prosedur serupa untuk jenis penyakit lain

Selesai